



## Populations and Ecosystems Ecoscenarios



# Yellowstone National Park

## INTRODUCTION







Courtesy of Teri Dannenberg

Lower falls of Yellowstone River. Yellowstone National Park got its name from the yellow rhyolite seen in the canyon walls.

Yellowstone National Park may be the best-known national park. It is noted for its many beautiful sights. There are mountain slopes covered in [taiga](#) (TIE•guh) forest surrounding grassland valleys, raging rivers, and spectacular waterfalls. Wildlife, such as, [elk](#), [bison](#), and [moose](#), can be regularly seen. The geothermal pools and geysers that dot the landscape make this a remarkable place to visit. Yellowstone National Park is America's first national park. It was the first place in the world set aside for people to preserve and enjoy the beauty of the land and the resources it offered.

Volcanism began in Yellowstone about 50 million years ago during the period when the Rocky Mountains formed. Yellowstone National Park is above an old hot spot in Earth's mantle. A dome formed 600,000 years ago as the magma was forced upward. The rock over the magma body collapsed and formed a huge caldera, a large bowl-shaped depression. Eruptions of rhyolite, tuff, and ash poured from the fractured rock. As the remaining magma body slowly cools, groundwater is heated to create the largest grouping of geothermal features in the world.

---

	
Art Explosion	Art Explosion
Geothermal pools bubble and steam with water heated by a magma body deep underground.	Geysers push hot water and steam up to 55 meters (180 feet) into the air.

The first known inhabitants of the Yellowstone area were the Sheepeater Indians, a band of Shoshone. The area was used by other bands of Native Americans as they traveled through the valleys, but only the Sheepeaters made permanent settlements here. The Minnetaree called the river Mi tsi a da zi or Rock Yellow River, because of the yellow canyon walls, and French fur trappers translated it to Yellow Stone.

John Colter was the first European American to describe Yellowstone. In 1805 Colter was scouting for the Lewis and Clark expedition when a Native American guide known as Old Toby led him through the Yellowstone area. His descriptions of geysers and other geothermal features were met with wonder and disbelief. The area was nicknamed Colter's Hell.

Mountain men, fur trappers, and gold prospectors visited Yellowstone in the following years. In 1870 an expedition led by Ferdinand V. Hayden, the head of the newly established U.S. Geological Survey, entered Yellowstone to explore and document the region. Artist Thomas Moran and photographer William H. Jackson accompanied the group. Moran's watercolors and Jackson's photographs finally conveyed the beauty and wonder of Yellowstone to the world.

On March 1, 1872, President Ulysses S. Grant signed the bill that established Yellowstone National Park and set aside 899,121 hectares (2,220,829 acres) as the first wilderness area for "the benefit and enjoyment of the people." The park became a popular spot for sportsmen and hunters to visit and soon began to show signs of poaching and vandalism. In 1894, Congress passed the Lacey Act which gave protection to all wildlife in Yellowstone, except for [wolves](#) and [coyotes](#).




Courtesy of Teri Dannenberg

Grand Teton National Park is in the Yellowstone ecosystem.

Yellowstone National Park is in the greater Yellowstone ecosystem, which also includes Grand Teton National Park and several national forests in Wyoming, southern Montana, and eastern Idaho. During its first year as a national park 300 visitors explored Yellowstone. In 2001 the number of visitors was a staggering 2,758,710.

The most distinctive feature of Yellowstone National Park is the geothermal activity. Magma masses close to the surface create geothermal pools, ponds, and geysers. Geysers, like Old Faithful, throw super-heated water into the air. Old Faithful erupts every 76 to 100 minutes, and can send water over 55 meters (180 feet) into the air. Hot springs contain water heated by the same underground magma. Steam rises from these pools, carrying with it vapors that have the rotten-egg smell of sulfur. Fumaroles (steam vents) occur when there is not enough water for a hot spring. Mudpots form when a hot spring becomes choked with mud. The super-heated mud bubbles and simmers like a pot of thick soup. The water in these pools is so hot that few organisms can live in them. However, they are home to [cyanobacteria](#) (blue-green algae) and [algae](#) adapted to live in geothermal water. These color the geothermal areas yellow and orange.

---

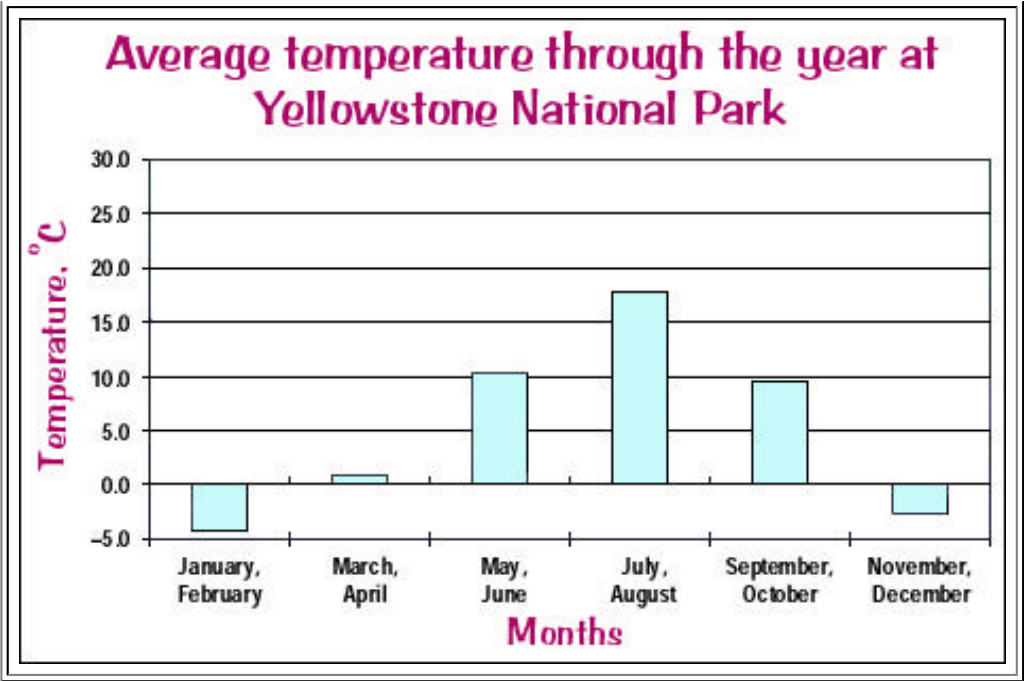

Art Explosion
Colorful algae and cyanobacteria are among the few organisms that can survive in geothermal pools.

The greater Yellowstone ecosystem includes many different habitats. In addition to the unusual thermal pond ecosystems, there are freshwater lakes and streams, sagebrush scrub, grasslands, alpine forests, and alpine meadows. The dominant habitat is [taiga](#), or boreal forest. Taiga grows in regions of cold continental or subarctic climates, characterized by long, cold winters and short summers. In the taiga, the dominant plants are coniferous trees like [lodgepole pines](#) and spruce. The conelike shape and needled branches of these trees help them shed the snow that covers them each winter. Yellowstone National Park has a reputation as wonderful wildlife habitat. Year-round, visitors come to see [elk](#), [moose](#), [bison](#), [mule deer](#), [coyotes](#), and [bears](#). If visitors are especially lucky, they may see a [wolf](#) or one of the three species of large cats, such as the [lynx](#), that inhabit the park.

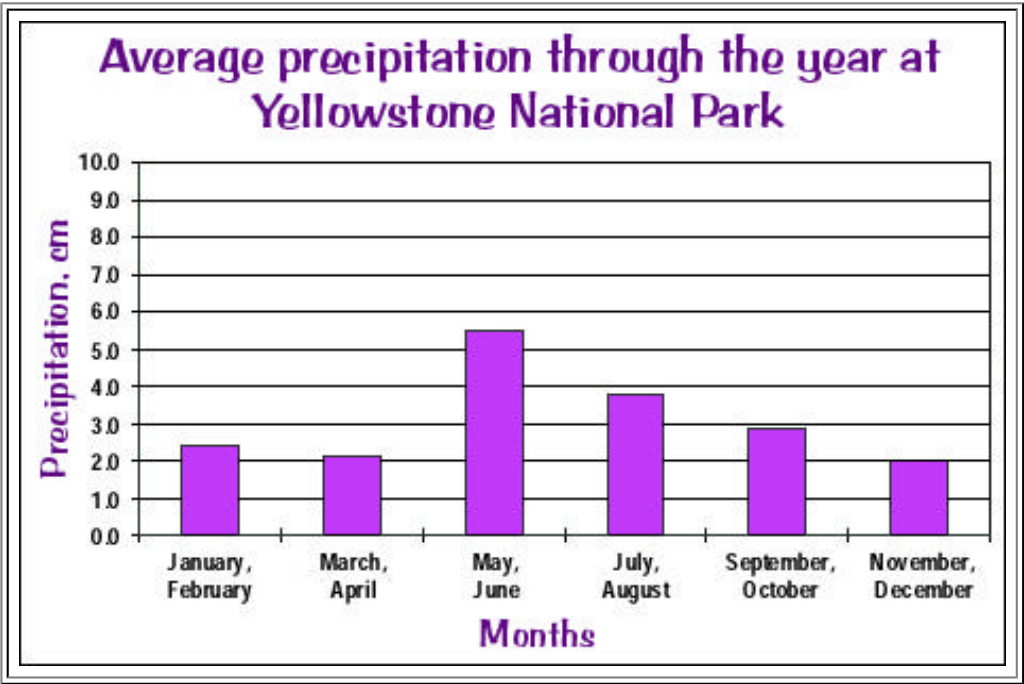
ABIOTIC DATA

Yellowstone National Park experiences long, cold winters and short summers. Temperature and precipitation are unpredictable. With elevations ranging from 1610 meters (5282 feet) to 3462 meters (11,355 feet), visitors can experience a wide range of temperatures and weather conditions in one day.


	
Courtesy of Teri Dannenberg	Art Explosion
Snow can fall anytime of year. Snow covering these arrowleaf balsamroots fell in June.	Bison graze in a meadow covered by deep snow. They use their massive heads to sweep snow away from vegetation.



In autumn, snowstorms become increasingly common. By early November, all but a few roads into the park are closed by snow. In the winter, average snowfall is near 380 centimeters (150 inches). Temperatures may drop lower than the  $-20^{\circ}\text{C}$  ( $-4^{\circ}\text{F}$ ) average when cold Chinook winds blow from the north. A record low temperature of  $-54^{\circ}\text{C}$  ( $-66^{\circ}\text{F}$ ) was recorded at Madison in 1933. The only areas not covered by a thick blanket of snow are the thermal areas. Warm waters from hot springs flow into streams and rivers and keep the water flowing year-round.





Even into the spring, 30 centimeters (12 inches) of snow can fall in 24 hours. The summer is rainy, with afternoon thunderstorms in July and August. Unexpected snows can fall at the upper elevations.

	
Courtesy of Teri Dannenberg	Courtesy of Teri Dannenberg
Mudpots are geothermal pools that have become clogged with carbonate mud.	Fumaroles spew steam from small fissures in the ground.

Yellowstone National Park is considered to be geothermally and seismically active. A magma body beneath Earth's surface heats the surrounding rocks. These hot rocks in turn heat groundwater to over 200°C (400°F). At this temperature, steam usually forms. But in underground chambers, pressure keeps the water in its liquid state. This super-heated water forms the hot springs, geysers, and other geothermal features of Yellowstone.

If the super-heated water comes to the surface slowly and gradually loses its heat, a hot spring forms. If pressure builds up in an underground chamber, however, the water can be forced to the surface quickly through a small opening. A geyser results. During the eruption, the pressure is released and the geyser stops. After a time the pressure builds to produce another eruption. The time between eruptions is unpredictable for most geysers. Old Faithful geyser was named because of its short and predictable cycle. It erupts every 76 to 100 minutes. There are over 300 geysers and 10,000 thermal features in the park.

Yellowstone has more geysers than anywhere else in the world. Over 75% of the geysers on Earth are here. Some are rare acid geysers. In addition to being very hot, these geysers, and their surrounding pools have a pH as low as 3.3 to 3.8. Compare this pH to that of fresh water (near 7) or vinegar (3).

	
Art Explosion	Art Explosion
Tourists visiting a geothermal area can see hot springs, geysers, fumaroles, and mudpots.	Steam from super-heated water rises from a hot-spring pond. Nearby trees cannot survive the very acidic water and steam.

Because of the recent volcanic activity, the entire greater Yellowstone ecosystem is subject to earthquakes. Most are minor, and only a few can be felt. The earthquakes cause the water that flows to hot springs and geysers to

change periodically.

As with all forests, fire is an important abiotic factor. Years of fire suppression in Yellowstone resulted in buildup of dry underbrush. In 1972 Yellowstone National Park managers decided to let fires burn themselves out. Between 1972 and 1987 there were over 200 forest fires in Yellowstone National Park. Most of these fires were small and went out quickly. In 1988 it was different. A fire burned more than one-third of the park. Many people criticized the National Park Service for their "let it burn" policy. These people felt that the forests were destroyed. However, many plants, such as the [lodgepole pine](#), respond quite well to fires. The ecosystem in Yellowstone National Park has been able to recover.



Courtesy of Teri Dannenberg

Forest fire at Yellowstone in 1988



Courtesy of Teri Dannenberg

Firefighters on the scene

Forest fires assure a healthy forest by clearing the forest floor of accumulated debris and opening the forest canopy. Meadows are quickly covered by [grass](#), [wildflowers](#), and [aspen](#) saplings following a fire. Shrubs and rapid-growing aspen take over a few years later. The aspen cover protects small lodgepole pines. As the aspens reach maturity and begin dying, the pines are tall enough to dominate the forest. Forest fires clear mature [lodgepole pine](#) stands to begin the cycle again.



Courtesy of Teri Dannenberg

Open paths left on this ridge after the 1988 fire will become meadows.






Courtesy of Teri Dannenberg

New growth the year after the 1988 fire. Wildflowers, grass, and saplings spring up in a newly opened meadow.

BIOTIC DATA

[Lodgepole pines](#) dominate the taiga of Yellowstone. [Quaking aspen](#) trees add to the forest canopy. In the open forest meadows you find [arrowleaf balsamroot](#) and [wheatgrass](#). Rodents, such as [yellow-bellied marmots](#) and [chipmunks](#), live in the meadows and forest. [Moose](#) graze on [pond lilies](#) in the streams and ponds. Birds, such as [dippers](#), trumpeter swans, osprey, and [mallard ducks](#), visit the ponds and streams for their meals. [Beavers](#) build dams and their lodges in streams and change the landscape. Blocked streams eventually fill with sediments and become meadows.

	
Courtesy of Teri Dannenberg	Courtesy of Teri Dannenberg
A beaver dam slows the flow of a stream, and the beavers build their lodges in the quiet pool that forms behind it.	Mallard ducks have used this beaver lodge as a nesting site. The female and ducklings are camouflaged by vegetation growing on top of the lodge.


Courtesy of Teri Dannenberg
A stream with a beaver dam and lodges slowly fills in the valley and over time becomes a meadow.

The most abundant large mammal in Yellowstone is the [elk](#). Their numbers vary with the seasons. In summer there are seven or eight herds, totaling almost 30,000 animals. In the winter, many elk migrate out of the park, many to an elk refuge near Jackson, Wyoming. About 15,000–22,000 elk winter in the park.



Courtesy of National Park Service

Male elk, or bulls, are often solitary.



Courtesy of Teri Dannenberg

Female elk (cows), calves, and yearlings stay in herds that are led by a dominant bull elk.

On the rocky cliffs of Yellowstone's mountains you might spot [bighorn sheep](#). These sheep can walk on the steep cliff faces, making it possible to avoid less-nimble predators. In the densely wooded slopes [bears](#) search for the sweet fruit of [wild huckleberries](#). Down in the flat grasslands, [bison](#) and [pronghorn antelope](#) graze on grasses and sedges. In the northern sections of the park, the snow is not as deep in winter. Here you might see a [bobcat](#), because bobcats avoid deep snow. Wildcats, like bobcats and [lynx](#) that also occur in the park, are rarely seen. The cats are most active at night, and avoid people.



Courtesy of Teri Dannenberg

Two bighorn rams facing off before fighting by crashing into each other with their horns.

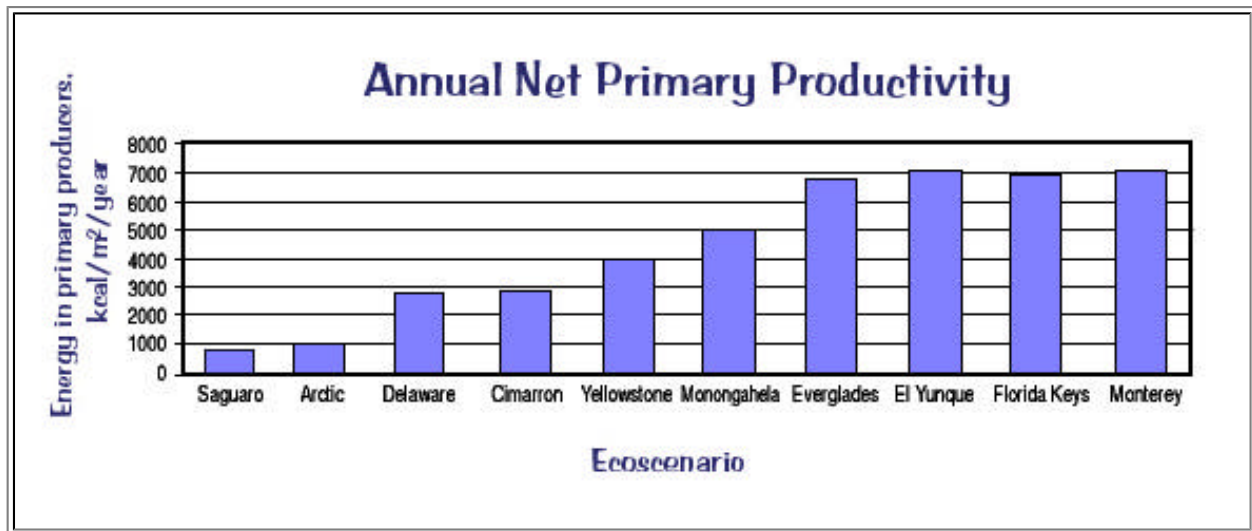


Courtesy of Teri Dannenberg

Marmots make their homes under rocks and rubble.

[Black bears](#), [brown bears](#), [coyotes](#), and [wolves](#) are difficult to spot, but sightings are more common now that their numbers are increasing. Wolves can be heard calling to each other in the night.

Annual productivity, or the amount of energy provided by the producers in this ecosystem, is high, 3600 kilocalories/square meter/year of plant material.



## ISSUES

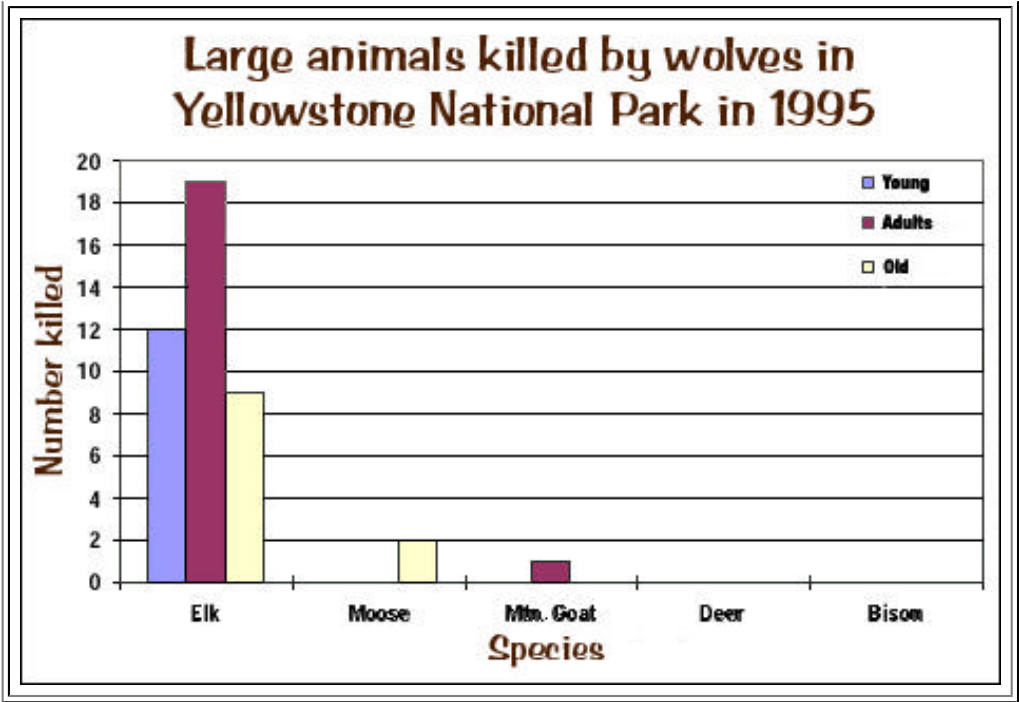
In the early 1900s in an effort to stabilize the herds of [elk](#), [bison](#), and [mule deer](#), predators ([wolves](#), [cougars](#), and [coyotes](#)) were removed or eliminated from the park. By the time it was discovered that it was not predators, but reduction of winter grazing lands, that had caused the decline, the population of wolves had become dangerously small. Wolf sightings became rarer and rarer until 1970, when no wolves were reported in Yellowstone National Park.

The reintroduction of wolves has been an issue at Yellowstone National Park. National park policy calls for the restoration of a species when sufficient habitat exists to support the population, management can prevent threats to outside interests, the restored species is almost identical to the lost species, and the loss of the species is the result of human activities.


[Wolves](#) were in the Yellowstone ecosystem before the park was founded in 1872. Wolf-removal programs were instituted to benefit the elk, deer, and moose. By the 1940s sightings of wolves had become rare. In the 1970s there was no evidence that breeding pairs of wolves remained in Yellowstone.

The wolves were gone, but the population of elk continued to decline. Yellowstone National Park began managing the elk population, and their numbers increased from 3100 in 1968 to over 30,000 today. Park managers say that elk are returning the Yellowstone ecosystem to a natural balance, in which elk numbers are limited by food supply. Others worry that there are now too many elk and that they are changing the landscape of Yellowstone from forest to elk grazing land. Elk browse on tender [aspen](#) saplings, reducing the number that mature. This disrupts the normal forest succession in Yellowstone.

In 1978 the U.S. Fish and Wildlife Service proposed the reintroduction of wolves into the Yellowstone ecosystem. It was predicted that the populations of elk, bison, mule deer, and moose would be regulated by wolf predation. Ranchers and hunters outside the park immediately opposed reintroduction. Ranchers were worried that wolves would find [cattle](#) and [sheep](#) easier prey than elk. Hunters were worried that elk populations would be reduced and that fewer hunting permits would be issued.



In autumn 1995, amid the protest of ranchers, 14 Canadian [gray wolves](#) were released in the Lamar Valley of Yellowstone National Park. The next year, 17 more wolves were released at Blacktail Plateau and Firehole Valley. The wolves each had a radio collar so their movements could be monitored.

	
Art Explosion	Art Explosion
A wolf feeds on a deer carcass.	Female wolf with pups

Some people tried to stop wolf reintroduction, claiming that it was illegal. They wanted the gray wolf removed from areas in which it was released. The wolves that were released had been raised in Canada. Some people were upset that the wolves had come from so far away. In January 2000 the wolf reintroduction program was ruled legal. As of December 2001 there were about 216 wolves in the park, living in 24 packs. There are 14 breeding pairs. Usually there is one breeding pair for each pack of about ten wolves. People are also discussing whether gray wolves should

be released in other wild places in North America, such as the southern Rockies of Wyoming, Colorado, and northern Utah.

## THE DEBATE

Before making decisions that affect an ecosystem, it is important to gather information from a variety of sources. Below are the views of several individuals or groups that have an interest in the future of the Yellowstone ecosystem. After each quote the hyperlink goes to the original source of the quote. Refer to these sites for more information.

Use the information provided to decide where you stand on this debate.

### DEBATE: Should wolves be reintroduced to the Yellowstone ecosystem?

#### People who support the reintroduction of wolves to the Yellowstone ecosystem

##### *Wildlife biologist*

"Wolves will not be a threat to humans or livestock. We won't find them hanging around the garbage dumps like bears. There are plenty of elk, and wolves are not going to be attracted to areas where people live."

*National Park Service, Yellowstone National Park, Wolf Restoration to Yellowstone*

"Their social structure and pack behavior minimizes their need to scavenge food or garbage available from human sources. Compared to bears, whose diet is predominantly vegetarian...The wolves' primary need is for prey, which is most likely to be elk, deer, and other ungulates in these recovery areas."

<http://www.nps.gov/yell/nature/animals/wolf/wolfrest.html>

##### *Ecologist*

"The wolves have been successful in establishing territories in the park. They have become a part of their ecosystem again."

*National Park Service, Yellowstone National Park, Wolf Restoration to Yellowstone*

"An estimated 20,000 park visitors have observed wolves since their return in 1995. The program's visibility has resulted in opportunities to educate audiences about predator-prey relationships, endangered species restoration, and the importance of maintaining intact ecosystems."

<http://www.nps.gov/yell/nature/animals/wolf/wolfrest.html>

##### *Wolf researcher*

"The wolves are meant to be in this ecosystem. Even when we try to help them re-establish packs, they manage to do well without us."

*National Wildlife Federation, Rebirth of Yellowstone's Wolves: The Saga of the First Wolf Pups Born in the Region in Seven Decades*

"A fierce summer storm swept through the area, knocking down the holding pen's fences. Moments later, the pups fled the compound. Phillips and other Park Service staff eventually returned six of the youngsters to their mother. The other two eluded capture and soon found an adoptive parent: a year-old male from another pack called Number 8."

<http://www.nwf.org/nationalwildlife/1997/wolfas7.html>

#### People who oppose the reintroduction of wolves to the Yellowstone ecosystem

##### *Resident of Jackson, Wyoming*

"The wolves are going to get used to people and soon they will be coming into our towns looking for food. We have had this problem with coyotes in the past. It will be too dangerous for children to play outdoors."

*Bearman's Yellowstone Wolf Update*

"In the past, coyotes have been fed by visitors, only to then attack cross country skiers and sometime visitors standing near the roadway after they become habituated to humans and learn that humans often have food with them. Wolves could do the same thing, and they also will lose any fear they have of humans and leave the park, placing them in even greater danger."

[http://www.yellowstone-bearman.com/w\\_update.html](http://www.yellowstone-bearman.com/w_update.html)

##### *CNN Interactive, Wolves' Return to Yellowstone Sparks Controversy*

"(Wolf) number 27 killed almost 50 sheep a few weeks ago, and had to be destroyed. The rancher who lost sheep was compensated with money from Defenders of Wildlife, a pro-wolf group."

<http://www.cnn.com/EARTH/9711/12/yellowstone.wolves/>

*Rancher in Montana*

"As the wolves are multiplying, they are hunting farther away from their original areas. Livestock and even family pets are being killed."

*Timber Wolf Information Network, Status of Gray Wolf Recovery, Week of 6/22 to 6/28, 2002, Gray Wolf Recovery Weekly Progress Report*

"An apparently lone wolf-like canid was confirmed to have killed a llama on private property near Big Fork, Montana. The area is a patchwork of ranchettes. At first it was suspected to be dogs because the llama was bitten in several places (not a clean kill) but then a wolf-sized track was found."

<http://www.timberwolfinformation.org/updates/yellowstone/index.cfm?start=24> Click Next until the report for the week of 6/22 - 6/28 2002 is displayed.

**Questions**

- Which side of this debate do you support?
- What scientific evidence supports your position?
- After looking at the evidence, did you change your position? Please explain why.

---

**WEB LINKS**

National Park Service, Official Website for Yellowstone National Park - <http://www.nps.gov/yell/home.htm>

American Park Network, Yellowstone National Park - <http://www.americanparknetwork.com/parkinfo/ye/>

Bearman's Yellowstone Wolf Update - [http://www.yellowstone-bearman.com/w\\_update.html](http://www.yellowstone-bearman.com/w_update.html)

CNN Interactive, *Wolves' Return to Yellowstone Sparks Controversy* - <http://www.cnn.com/EARTH/9711/12/yellowstone.wolves/>

Meg Streepey, University of Michigan, *Geysers and the Earth's Plumbing Systems* - <http://www.umich.edu/~gs265/geysers.html>

National Park Service, Geology Fieldnotes, Yellowstone - <http://www.aqd.nps.gov/grd/parks/yell/>

National Park Service, Official Website for Yellowstone National Park, Wolf Pack Map - <http://www.nps.gov/yell/nature/animals/wolf/wolfup.html>

National Park Service, Official Website for Yellowstone National Park, Yellowstone Wildlife Pages - <http://www.nps.gov/yell/nature/animals/index.htm>

National Park Service, Yellowstone National Park - <http://www.nps.gov/yell/>

National Park Service, Yellowstone National Park, *Wolf Restoration to Yellowstone* - <http://www.nps.gov/yell/nature/animals/wolf/wolfrest.html>

National Wildlife Federation, *Rebirth of Yellowstone's Wolves: The Saga of the First Wolf Pups Born in the Region in Seven Decades* - <http://www.nwf.org/nationalwildlife/1997/wolfas7.html>

Thomas D. Brock, University of Wisconsin at Madison, *Life at High Temperatures* - <http://www.bact.wisc.edu/bact303/b27>

Timber Wolf Information Network, *Status of Gray Wolf Recovery, Week of 6/22 to 6/28, 2002, Gray Wolf Recovery Weekly Progress Report* - <http://www.timberwolfinformation.org/updates/yellowstone/index.cfm?start=5>

The Total Yellowstone Page - <http://www.yellowstone-natl-park.com/>

The Total Yellowstone Page, *Wolf Report* - <http://www.yellowstone-natl-park.com/wolf.htm>

University of Utah, Seismology and Active Tectonics Research Group, *Yellowstone Hotspot* - <http://www.mines.utah.edu/~rbsmith/RESEARCH/YellowstoneHotspot.html>

U.S. Geological Survey, *Geysers, Fumaroles, and Hot Springs* - <http://pubs.usgs.gov/gip/volc/geysers.html>

Western Treasures, dedicated to the Nez Perce and Wyoming, *Early History of Yellowstone National Park* - <http://www.nezperce.com/yelpark9.html>

YellowstoneNationalPark.com - <http://www.yellowstonenationalpark.com/index.htm>

Yellowstone.net, *Yellowstone National Park History* - <http://www.yellowstone.net/history.htm>

Yellowstone-Park.net - <http://www.yellowstone-park.net/Default.htm>

---